REMARKS

Summary of Amendments

Claims 1 and 2 have been amended to clarify patentably distinguishing features of epitaxial-film-bearing GaN substrates according to the present invention.

Claims 4 and 6 through 10 were canceled in Applicant's reply to the Office's previous action on the merits, while new claims 11 and 12 have been added. Claims 11 and 12 recite a limitation presented in method claim 3, which as a result of Applicant's reply to the Office's April 8, 2008 requirement for restriction has, along with claim 5, been withdrawn.

Claims 1 and 2, and 11 and 12 are thus pending the Examiner's consideration on the merits.

Election/Restriction

Applicant acknowledges that, as just noted, claims 3 and 5 have been withdrawn as a result of Applicant's election of the subject matter to which claims 1 and 2 are drawn.

Claim Rejections – 35 U.S.C. § 103

Claims 1 and 2: Amano et al. '309 in view of Higgs et al. '217

Claims 1 and 2 were rejected as being unpatentable over newly cited U.S. Pat. App. Pub. No. 2004/0213309 by Amano et al., in view of U.S. Pat. App. Pub. No. 2004/0106217 by Higgs, also newly cited.

Amano et al. is apparently cited to demonstrate, in the first place, teaching of GaN as a substrate for a device-forming layer structure 40 that includes, as Fig. 3 of the reference shows, both GaN layers (waveguide layers 45, 48; contact layer 50) and a GaInN layer (active layer 46). The Office presumably cites *Amano et al.* paragraph [0079] specifically because it states that the layer structure 40 can be formed on GaN as an alternative to forming the structure on sapphire or silicon carbide.

Amano et al. is apparently cited also to demonstrate that after the layer structure 40 is formed on the substrate, the substrate is free of contamination by "a metal." The Office presumably cites *Amano et al.* paragraph [0090] specifically because it states that the layer structure 40 is formed by a suitable epitaxial deposition technique, preferably MOVPE. That is, it appears that the Office's position is that because formation of the layer structure 40 would be carried out in an environment completely

absent of, for instance, copper, it may be said that, as noted at the bottom of page 2 of the Office-action communication, "the GaN substrate surface [of an *Amano et al.* substrate] has zero density of copper."

The Office then cites *Higgs* to show prior-art teaching of characterizing the presence of metal contamination in a semiconductor material by irradiating it with a laser, and collecting and examining the resulting photoluminescence (PL). In paragraph [0014], Higgs teaches that his method can identify, in silicon, copper contamination particularly in a density range of 6×10^{10} to 4×10^{12} atoms/cm^2.

Although in some places in the *Higgs* description the Higgs PL-based contamination-detection technique is set forth in general terms, from an overall reading of the specification, it is clear that *Higgs* is exclusively concerned with detecting copper contamination in silicon. Paragraph [0016], for example, states:

> The surprising nature of the invention relies on the finding that copper not only provides a unique PL finger print which is uniquely identifiable at a particular concentration level, but that the copper contamination within a wafer falls within this concentration due to its tendency for diffusion throughout silicon.

Moreover, not only is *Higgs* silent as to characterizing nitride substrates, but also as to examining the photoluminescence from an epitaxial film on any sort of substrate. An overall reading of *Higgs* indicates that the reference is concerned with detecting metallic contamination in "silicon structure[s]," in particular, post-metallization semiconductor devices built on silicon.

Meanwhile, the Office asserts that *Higgs* teaches "the use of a beam of a predetermined wavelength" to characterize a substrate for surface or near surface metal contamination. Yet *Higgs* does not expressly address using photo-luminescence to characterize substrates on which device-forming films have been deposited. Moreover, the "near-surface" contamination mentioned in *Higgs* does not mean contamination "over or above" the surface (which is where a device-forming film could be described as being); rather, "near-surface" contamination therein means wafer-internal contamination that is near—i.e., below—the surface.

The relevance of *Higgs* to the present claims is moot, however—as is the issue of whether a proper rationale for combining *Higgs* with *Amano et al.* has been demonstrated—because claims 1 and 2 have been amended to eliminate the recitation characterizing the special metal-atom density level of the claimed GaN substrates according to photoluminescent emission from the substrates as bearing an epitaxial, device-forming film. Specifically, claims 1 and 2 now recite:

> A gallium-nitride semiconductor substrate onto which a light-emitting-device-forming film has been epitaxially grown, the gallium-nitride substrate therein contaminated on its epitaxial-film side by one or more of the metals Si, Cr, Mn, Fe, Ni, Cu, Zn and Al at a density level of from 15×10^{10} to 10 *{claim 1}* / 5 *{claim 2}* $\times 10^{11}$ atoms/cm^2.

Hence, it is respectfully submitted that by the present amendments to independent claims 1 and 2, not only has *Higgs* been rendered irrelevant as a reference teaching photoluminescence-based characterization of metal contamination in semiconductor substrates, but also *Amano et al*. has been rendered inapplicable to the present invention being a GaN substrate contaminated, as now recited in claims 1 and 2, on its epitaxial-film side by one or more of the metals Si, Cr, Mn, Fe, Ni, Cu, Zn and Al at a density level of from 15×10^{10} to $10 / 5 \times 10^{11}$ atoms/cm^2.

Applicant notes that neither *Amano et al*. nor *Higgs* sets forth a metal-atom density level of from 15×10^{10} to 10×10^{11} atoms/cm^2. And while Fig. 1 of *Higgs* sets forth an Si substrate-surface copper density of 6.0×10^{-10} atoms/cm^2 and Fig. 3, a density of 4.0×10^{-12} atoms/cm^2, the substrates in *Higgs* are silicon exclusively; thus it is quite clear that because the substance differs from the GaN of the present claims, the *Higgs* impurity concentrations are irrelevant.

Conclusion

Accordingly, Applicant courteously urges that, inasmuch as the rejections of independent claims 1 and 2—the sole independent claims pending—have for the foregoing reasons been overcome, this application is in condition for allowance. Reconsideration and withdrawal of the rejections is requested. Favorable action by the Examiner at an early date is solicited.

Respectfully submitted,

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